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Sample Elemental Composition Evolutions in the Materials Test Station

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Abstract

Evolution of the elemental composition of materials during high energy irradiations can affect mechanical properties. Phosphorous and sulfur production from spallation are of particular interest in steels. For the Materials Test Station (MTS) at the Los Alamos Neutron Science Center (LANSCE), spallation induced composition changes raise concerns with the suitability of the facility for fusion materials irradiations. The MTS neutron spectrum is close to that of a fast reactor, but includes a high-energy tail as a result of its being a spallation neutron source. We are calculating composition evolutions for materials samples in MTS using the MCNPX and CINDER codes and comparing results obtained using the Bertini-Dresner (MCNPX default), INCL4-ABLA, and CEM03 physics models with the composition evolution in the neutron spectrum of the Demonstration Power Plant (DEMO) first wall. We have calculated evolutions for the low activation steel EUROFER97 and plan to calculate them for other candidate structural materials for fusion systems including the refractory alloy V-4Cr-4Ti, silicon carbide, pure tungsten, and tungsten-rhenium alloys. Calculated phosphorous and sulfur concentrations from transmutation of EUROFER97 samples using INCL4-ABLA are about half those obtained using the default physics options, but in either case are small compared to initial concentrations of these elements in the material and not sufficient to be a fusion materials irradiation concern.